The Citrus Industry

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A MAGNIFICIENT ACHIEVEMENT

It has frequently been said, usually by citrus growers themselves, that citrus growers, and particularly Florida citrus growers, could never unite on any program of any nature whatsoever. The fallacy of that statement has been definitely refuted many times during the past year.

When the government inaugurated its scrap rubber drive it was the citrus growers of Florida who led the procession and put the drive over the top many times over. Again, when the government asked the people to contribute scrap metal for war purposes, it was the citrus growers of Florida who set the pace and turned in an almost unbelieveable amount of discarded metal. There were no laggards among citrus growers in either drive. They acted with unanimity and enthusiasm, and the results were astounding.

But when last winter a small group of citrus men meeting in Winter Haven decided to ask the citrus growers, packers, shippers and allied interests to contribute $9,000,000 for the purchase of thirty army bombers, many said that the impossible had been asked. Nine million dollars meant approximately $1,000 for each real commercial citrus grower in the state; $700 each if we include all the little growers who own a few trees in the back yard. Many said it could not be done, but the leaders of the movement believed that it could and would be done.

A lively campaign was inaugurated, meetings were held, personal solicitations were made, advertisements were invoked and the campaign went merrily on. A few days ago John A. Snively, jr., who headed the campaign organization, reported that the work had been completed, the campaign was ended, and instead of the $9,000,000 originally set as the goal, a total of $65,000,000 had been subscribed. Instead of the thirty bombers sought by the originators of the campaign the Army Air Force has set aside 200 bombers to be designated as the "Florida Citrus Bomber Air Force." Already "Gertie Grapefruit, the Blonde Bomber," "Ophelia Orange," "Tillie Tangerine," and "Lulu Lime" have been christened. Others are on the way.

Florida citrus growers, packers, shippers and allied interests may be divided into groups, cliques and clans on questions of industry policy, but when it comes to helping Uncle Sam they all see eye-to-eye and act as one man. Let it not be said again that Florida citrus growers cannot unite on a program which appeals to their patriotism or sense of justice. They have done more than their share in every movement designed to obliterate the Axis —and are ready to do still more.

RESEARCH FOR CITRUS

Citrus growers generally will applaud the recent action of the Florida Citrus Commission in appropriating the sum of $49,000 for research work during the coming year. This action was at the recommendation of Dr. L. G. MacDowell, Research Director for the Commission.

The fund will be used in carrying on research projects now under way and for the promotion of new research projects in fields as yet untouched. Many new uses for citrus have been developed during the past few years; many others, we believe, will be discovered as a result of research work thus authorized.

"SINGLE STANDARD" FOR CITRUS

In line with recent discussions and preliminary conferences, a "war problem committee" of Florida citrus growers has given endorsement to a proposal under which a single ceiling would be placed on the retail price of citrus throughout the nation regardless of the point of production. This is in line with plans discussed at a meeting some months ago in Texas.

Texas and California citrus interests are said to be favorably inclined toward the plan, which would seem the only feasible and equitable way of applying ceilings to citrus fruits.

PERMANENCE ASSURED

In reviewing the history of citrus culture on an extensive scale in the Lower Rio Grande Valley of Texas, the Mission Times says that the industry has experienced many "ups and downs during that period—with perhaps more downs than ups." Hurricanes, freezes and a period of low prices did much to discourage owners of the new groves; an experience with which Florida citrus growers may well sympathize.

However, says the Texas paper, the industry in the Rio Grand Valley is now established on a permanent basis. Some groves, it is said, paid

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A Resume Of Feeding And Spraying Citrus Trees . . . From A Nutritional Viewpoint

By DR. A. F. CAMP
Assisted By The Staff of the Citrus Experiment Station, Lake Alfred, Florida

Introduction

We have been asked to present in a condensed form the recommendations that the Citrus Experiment Station might consider would cover a complete program for the production of citrus, including in particular the details of the fertilizer ratios which have been found best. The reasons given for the request were (1) that at the present time such recommendations are not available anywhere in a complete form and (2) the known information on which the recommendations have been made has not been brought together in one place so that it is easily available. The suggested field is so broad that this paper must necessarily be rather long; however, an attempt will be made to cover the matter as thoroughly as possible. Although the principal citations to date will be given, no attempt will be made to give a complete bibliography but rather to list the most important references bearing on the subject and in particular those which are valuable as reference works.

History

The early citrus growers understood little of the problems of cold protection but did recognize good dark soils so they chose hammock soils and other relatively heavy soils when they planted their groves. An examination of the soil analyses in Peech's bulletin (18) will reveal that these soils were incomparably more fertile than the sandy soils now commonly used. The pioneers in the citrus industry were limited too by the use of sweet orange and sour orange stocks which did not thrive on lighter soils with the inadequate fertilizer programs of that day, and this further confined them to planting the heavier soils.

As time went on and the use of fertilizer progressed from the "cow-pen" stage to the use of commercial fertilizers, the use of natural organics became widespread. Bone meal for phosphate and nitrogen, tankage and vegetable meals for nitrogen and other materials of a similar nature which carried with them valuable impurities of magnesium, manganese, copper, zinc, boron, etc., were the basic materials in the manufacturing of fertilizers. Added to this was the widespread use of hardwood ashes with their content of calcium, magnesium, and potash. As a result the groves thrived because of the presence of these needed elements both as natural constituents of the soil and as impurities in the fertilizer used. Groves would do reasonably well even on sandy soils if the same fertilizer program were used as witnessed by the plots at the Citrus Experiment Station which received all of their phosphate from bone meal and produced fruit with only a minimum of deficiencies while plots receiving only inorganic nitrogen, superphosphate, and sulfate of potash nearly died of acute deficiencies. The difference was in the content of magnesium and other elements in the bone meal as well as the phosphate, nitrogen, and calcium for which the bone meal was primarily used.

Also, it should not be forgotten that for every acre of these old groves known to you probably many acres have passed away because of adverse soil conditions so that not all conditions were as favorable in pioneer citrus growing as many are inclined to believe. More than this, production requirements and quality were relatively less important then than now. In retrospect, things often seem better than they were.

Unfortunately, many of the best soils planted to citrus were in low, cold places and freezes in time deemphasized the importance of the soil and emphasized instead the question of cold protection. Growers now sought warmer and warmer locations and struggled to make the best of the soils found in such locations. The discovery that rough lemon stock would grow trees on the light sands in the warmer locations resulted in a tremendous wave of planting on these soils which had little natural fertility but which did have the one factor believed to be necessary, i. e., cold protection. Fertilization now became of extreme importance. It was no longer supplementary fertilization of a relatively rich soil but rather the mainstay of production. This was not so bad as long as the older types of fertilizers were continued in use along with hardwood ashes but unfortunately there set in a gradual decline in the use of natural organics. First, it was bone meal with its sizeable content of magnesium which was discarded but later even the common organic nitrogenous materials were discarded in favor of inorganic forms of nitrogen which were almost totally lacking in important impurities but had the advantage of cheapness. This trend reached a peak with the declining

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The Agricultural Situation

By H. G. CLAYTON, Administrative Officer In Charge, Agricultural Adjustment Administration, At Meeting Florida State Horticultural Society

In 1942 production was the greatest in history. The 1943 production goals call for approximately a 12 percent increase over the 1942 production. The production goals are an effort to channel and utilize production facilities into the more essential items and to reduce production of less essential items.

Certain price supports are available to put a bottom under prices to encourage and enable farmers to produce.

In an effort to control inflation price ceilings have been placed on certain crops at the farmers' level, others apply at the wholesale or retail levels. The principal and objective has merit, however ceilings and other restrictions are difficult to operate especially for perishables and unless they are operated equitably and adjusted promptly to meet almost individual conditions, they may cause reduced production.

In general, the best answer for rationing and equitable prices is adequate production to meet the needs coupled with efficient distribution.

Agriculture and the allied industries connected with getting food and fibre crops produced and placed into the hands of the ultimate consumer when needed and in the farm used to supply his essential needs is a complicated and often a delicately balanced operation with many ramifications which involve numerous separate industries and interests. No person knows all that is involved and when various separate steps are taken to do certan definite things these are likely to react in unexpected places and in unforseen ways that may hinder rather than help the war effort.

Florida is in a peculiar position as our growing season does not coincide with the greater portion of the nation. Often regulations and national programs based upon national statistics and calculations do not fit our conditions and production schedules. In a war time economy it will likely never be possible to have things lined up as we would like them or as would be for the best interests of all concerned. We must and do expect that adjustments must be made locally down to individual farms in many cases, to do everything possible to continue production in spite of seemingly unnecessary obstacles.

Our farmers with their production problems and the related industries that supply, transport, and market our products and the items that go into production have taken a very fine attitude in general and this is why we have done as well as we have. In Florida we have a close tie-up through the Agricultural Division of the State Defense Council that has been very helpful. The War Board and the Defense Council maintain close contact which affords opportunity to obtain the facts to support requests to Washington and to present the Florida situation in a manner based upon unbiased and complete facts that helps to get national regulations drawn to reflect and provide for our particular situation and condition. This has been very effective and I believe we have the confidence of the people in Washington which has helped many ways not known to the public generally. The people in Washington who hold responsible positions have generally been fair and considerate of our requests and have gone out of their way to assist us. Their problems are many and we have tried to fully justify and to suggest to them ways and means to meet or help solve our particular problems. The main principle followed has been to try to solve our problems at home and only when this could not be done, to go outside, after making sure we had the facts and that we were together at home first. In my opinion, Florida has probably done the best job of any state in handling our problems with Washington. I would now like to make a few broad comments on several items.

Labor is probably the most difficult problem confronting farmers. This now looks a little better. Draft regulations have been modified to afford at least limited relief. The government's policy for farm labor has been remodeled and the Extension Service is in charge of the new program. Some of the previous mistakes have been corrected and the program simplified. The Extension Service will be slow to promise more than it can do and it appears the program as now centralized will be an improvement since the administration will be largely handled locally at state levels. No agency will be able to supply all the labor needed and in every community the available farm labor and other labor that can be secured for agricultural use will have to be mobilized. This is the responsibility of the local people with such assistance as may be available. After everything possible has first been done locally to make full use of the labor available in that community is the time to ask for outside assistance.

Machinery. This problem is being gradually worked out. For 1943 the WPB originally allocated material for only about 23 percent of the 1940-41 average production of new machinery. This has now been increased to about 40 percent and parts have been stepped up to 160 percent. This added machinery is beginning to come through now. For 1944 the allocations have been increased to 80 percent and according to present plans are to be made early enough to get much of this made between now and fall. We have pulled off all county quotas and this will simplify and permit freer movement and distribution of the implements now available. If any growers are in urgent need of parts or implements they have not been able to get we will try to assist you if you will make your needs known preferably through your own County War Board. The machinery section in Washington have been very cooperative in locating and obtaining implements to meet emergency situations. There is nothing in the present picture however that would eliminate the need for repairing implements on hand and arranging to make the present machinery render maximum service.

Fertilizer and spray materials will be covered by others on this program; therefore, I will only say that our efforts have been largely confined to assisting to some degree in having regulations which provide for our conditions and to insist that sufficient quantities be provided to make rationing unnecessary. It is felt the 1943 program has worked out reasonably well and has probably operated more effectively and with less inconvenience than would have been the case with a rationing program.

Containers. Shortages have de-

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Studies Of Boron Deficiency In Grapefruit 1/

By WALLACE R. ROY, Associate Biochemist, Bureau of Plant Industry, U. S. D. A., At Meeting Florida State Horticultural Society

(Concluded From Last Issue)

Effect of rootstock on the boron content of citrus leaves

Two experimental plantings and one commercial grove presented an excellent opportunity to make an analytical study of the influence of rootstock on the boron content of the leaves of the tree budded thereon. The first planting, in a nursery, consisted of five varieties of scions, each of which was budded on a number of different rootstocks. The second experimental planting consisted of a block of four-year-old trees of 7 scion varieties, each budded on 6 rootstocks. The commercial grove referred to consisted of Marsh and Duncan grapefruit on both sour orange and rough lemon rootstocks, the four stock and scion combinations being in close proximity to each other, on a uniform soil, and receiving identical cultural treatment.

Leaf sample were taken from each of the trees in the same day, those of comparable age being carefully selected, and boron determinations made on the leaves. The results are presented in tables 3a, 3b, and 3c.

Table 3 a. Boron content of citrus leaves from a nursery block, various scion varieties on various rootstocks

	Scion				
Rootstock	Parson Brown orange	Valencia orange	Duncan grapefruit	Temple orange	Dancy tangerine
	Boron content p.p.m.				
Trifoliate	70	50	65	76	73
Cuban shaddock	74	68	71	80	54
Calamondin	28	30	26	35	30
Grapefruit (Duncan	60	—	36	56	38
Grapefruit (Bowen)	63	47	—	—	—
Sweet lemon	38	—	59	58	73
Suen Kat	52	—	45	51	59
Cleopatra	45	50	—	—	—
Rusk citrange	60	60	41	—	—
Kansu orange	49	—	45	54	—
Rough lemon	56	58	—	—	—
Sweet Oranges					
—(Parson Brow)	46	36	—	—	—
—(Pineapple)	53	—	—	45	35
Sour org. (Bittersweet)	23	—	24	26	30
Sour orange No. 2	22	26	32	39	—
Sour orange A	26	19	—	—	—
Sour orange No. 3	23	28	—	—	—
Sour orange No. 1	14	—	—	—	—
Morton citrange	—	—	—	43	—

Table 3 b. Boron content of citrus leaves from a young grove experiment, various scion varieties on various rootstocks

	Scion						
Rootstock	Parson Brown orange	Hamlin orange	Pineapple orange	Jaffa orange	Valencia orange	Temple orange	Dancy tangerine
	Boron content p.p.m.						
Valencia	41	40	47	41	42	54	72
Sweet orange (seedling)	56	40	55	53	46	54	61
Sour orange	33	25	—	28	27	39	55
Rough lemon	71	41	57	76	69	77	70
Grapefruit	52	57	61	79	100	59	—
Cleopatra	68	44	34	—	70	54	57

Table 3c. Boron content of grrapefruit leaves from adjacent blocks in a bearing grove

Scion	Rootstock	Boron p.p.pm.
Marsh grapefruit	Sour orange	49
Marsh grapefruit	Rough lemon	71
Duncan grapefruit	Sour orange	41
Duncan grapefruit	Rough lemon	90

It will be noted that almost invariably the leaves from trees budded on sour orange rootstock contained considerably less boron than did leaves from trees budded on other rootstocks, while leaves from trees on rough lemon rootstock contained a relatively high amount of boron. Leaves from trees budded on Calamondin, Cleopatra, sweet orange, and citrange rootstocks were found to contain smaller amounts of boron than leaves from trees budded on grapefruit, trifoliate, Cuban shaddock, sweet lemon, and Suen Kat.

While no attempt is made to predict the comparative influence of rootstock on susceptibility of budded trees to the group of sypmtoms characteristic of boron deficiency, it would appear from the above data that, all other factors being equal, trees budded on rough lemon rootstock should prove less susceptible to deficiency of the element in the soil than trees budded on sour orange, due to the obviously more efficient intake of boron by the former. However, in this connecton, Haas and Klotz (loc. cit.) stated that, based on their experiments, there is no reason to assume that one rootstock (rough lemon) is more resistant than the other (sour orange) to a deficiency of boron.

Summary

1. Boron deficiency was produced experimentally in grapefruit trees grown in sand cultures The leaf symptoms noted were: curling of the leaves, corking of the veins, and extensive defoliation giving rise to a die-back appearance of the tree. The fruit symptoms were: excessive dropping, formation of boron stains in the albedo, misshapen fruits, and formation of a drop of crystallized gum on the receptacle remaining on the trees after the fruit had dropped.

2. Application of large amounts of soluble arsenic to the nutrient solution supplied to boron-deficient trees did not prevent uptake of boron, but resulted in symptoms characteristic of boron deficiency.

3. The influence of rootstock on the uptake of boron is pointed out.

References

1. Berger, K. C., and E. Troug. Boron determination in soils and plants using quinalizarin reaction. Ind. and Eng. Chem. Analyt. Ed. 11: 5440-545. 1939.

2. Camp, A F. Citrus Industry 20: 6-7,18, 1939.

3. Haas, A. R. C. Boron as an essential element for the healthy

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1/ By error F. E. Gardner's name appeared in connection with this article. Dr. Gardner has requested that the identity of authorship be corrected.

A RESUME OF FEEDING AND SPRAYING CITRUS TREES FROM A NUTRITIONAL VIEWPOINT

(Continued from page 3)

fruit prices in the late 20's and early 30's when the advocacy of the cheaper forms of nitrogen reached almost the status of a religion, although not based on either experimental or practical evidence as to the soundness of the recommendation.

The combination of light soil, increased production with its consequent drain on the tree and soil, and the elimination of the incidental supply of needed elements formerly furnished by natural organics, rapidly culminated in a marked grove decline. The literature of this period is full of references (3 and 17) to the difficulty of maintaining groves in good condition on rough lemon stock and light sandy soils. The rootstock was emphasized because of the lack of soils information, although it was in reality the soil and the fertilization that were at fault (see Camp (5)). Even in the older groves on the better soils the change in fertilization began to result in soil exhaustion but as yet it was not acute.

The net result was that we arrived in the early 30's with groves on light soils acutely deficient in magnesium, manganese, copper, and zinc, production down, cost of production up, and a very doubtful future facing the groves on Norfolk, Blanton, and other light sandy soils. The opinion was freely expressed at that time that this was due to the use of rough lemon stock and that this stock was short-lived and would eventually pass out of the picture. Many people have forgotten just how serious the situation was at that time but all of the indications were that groves were declining rather than advancing. This, of course, was the result of the combination of factors mentioned above; namely, the deficient soil, the increasing production with its consequent drain on the soil, and the substitution of inorganic materials for the organic materials which carried as impurities those things needed in addition to nitrogen, phosphorus, and potash. Had the use of the older types of fertilizers been continued, the day of reckoning would have been delayed but as it was the whole matter came to a head with rather startling rapidity. A scanning of the Proceedings of the Florida State Horticultural Society for the years from 1927 to about 1933 shows a series of papers and discussions on this point.

In the early 30's the work on elements other than nitrogen, phosphorus, and potash began to yield definite results. Copper had been used in a small way for a good many years in Florida, probably going back to the early 1900's and becoming more extensively used after about 1912 (see Floyd (8) and Camp and Fudge (6)). Its use, however, was still a matter of last resort, and it was regarded as a medicine rather than as a nutrient. In 1931 bronzed tung trees showed immediate favorable response to the application of zinc (Mowry and Camp (14)) followed by similar results for frenched citrus trees, and this started an avalanche of experimental work which resulted in a few years in the definite determination that on most Florida soils magnesium, manganese, copper, and zinc should be integral parts of a nutritional program for citrus. This was not because the trees had developed a need for these elements but rather that they had always needed them and were now being grown on soils which did not contain them and were fertilized with materials which did not supply them as impurities. Many growers seem to feel that the feeding habits of citrus have changed, but this is not the case.

In the early days of this work and up to about 1937 the information was more or less divided into separate fields, each covering a single deficiency, and most of the treatments were corrective treatments so that the period might be called the period of corrective applications. There was no general program for the use of these elements; and growers were advised to apply a zinc spray if frenching occurred, copper sprays or applications of copper to the soil if dieback occurred, magnesium applications if bronzing occurred, etc. There was no correlation into a program of production, and the idea of combining these things into a program of production had begun to gain headway at the Citrus Experiment Station about 1936. The idea was that the dosing of trees to correct deficiencies was an erroneous procedure and that the plan should be to follow a program which would prevent the deficiencies from occurring. It was observed in experiments that have been reported in the Annual Reports at various times that when frenching occurred to the extent of being noticeable in a grove, production had already fallen off 25 percent or more. Also, the occurrence of bronzing in a grove meant that magnesium had become so deficient as to result in decreased yield. The idea of a program of prevention of deficiencies and the development of this program has occupied much of the time of the research men at the Citrus Experiment Station from 1936 to the present.

The recommendations as they stand are based on several factors. First are the plots themselves, both on the Experiment Station property and in cooperative groves. Plots laid out prior to 1931 have had to be discarded as valueless because they were based on only nitrogen, phosphorus, and potash ratios and suffered so acutely from deficiencies that no safe conclusions can be drawn from them; and only those plots which have the deficiencies limited to the one under consideration are of definite value. Second are the general blocks at the Experiment Station. When the idea of an overall program developed, these general plots were placed under programs which were developed from the information available from the early plots; and these programs were followed consistently and only varied as new information was developed. They form today probably the best basis for judging the value of various programs. Third are the commercial groves in which we have had a considerable hand in making the recommendations and which constitute a very large acreage. Fourth and finally was the contact we constantly have had with growers who are having grove difficulties. This has been very important because it has enabled us to anticipate the troubles which are likely to arise and to adjust the programs to avoid them.

The philosophy upon which the programs were based is a reversal from the older idea of waiting until trouble showed up and then correcting it, which might reasonably be called a philosophy of correction. Following this philosophy a grower did not spray for rust mites until they became numerous, or for scales until they started to do serious damage, or apply copper until dieback became serious. In contrast to the philosophy of correction, we have consistently followed a philosophy of prevention in which the program is designed to prevent the occurrence of those things which we have found are reasonably certain to become problems in the average grove. While it might be true that in occasional groves unnecessary things will be done under such a general program; nevertheless, if this group of unusual groves constitutes less than 5 percent of the acreage, then we have considered that it would be better to outline the program on what 95 percent of the growers might expect. Some growers will undoubtedly rise up in indignation at the idea that any general program can fit their particular grove, but actual practice has indicated that such a program is workable when based on sound soils information.

Obviously we cannot see every grove owner and recommend corrective measures, but we can recommend a program which should avoid the necessity of corrective measures. Moreover we have found that by the time corrective masures are obviously needed production has fallen off. The problem of zinc sprays is an excellent example of this; a zinc spray every third year will usually prevent serious frenching but we have found that by the time some frenching appears production will usually be off 25 percent or more. Our recommendations consequently are based on keeping up production rather than correcting frenching. The problem of examining every individual grove is about as difficult for a production manager with 3 or 4 thousand acres in scattered groves under his care as it is for us. He is, therefore, faced with the problem of either using a program which has been shown to prevent the majority of the usual pitfalls or else risk the chances of having a lot of groves in bad condition. Even in the case of the grower handling his own 20 or 30 acres,

we believe it is better to give him an overall program which we know to be satisfactory than to provide him with dozens of corrective measures and pages of descriptive matter which are likely to confuse him. Finally our program is based not on one year's performance but on the production of consistently large crops of good quality fruit, and at the same time it maintains the tree in excellent condition, able to resist drouth and cold to the maximum. Growers have experimented with programs time after time which would produce one to 5 good crops without difficulty but thereafter trouble would set in and the grove and its production decline. This can be emphasized no better than by reference to the inorganic nitrogen plots at the Citrus Experiment Station. Started on trees in good condition, they worked very well for several years and then declined and went out of production. (For production records of these plots, see Camp (4)). The trees were living on the reserves in the soil until they were depleted and then collapsed. Since the period of relatively good production ran into 5 or 6 years, it is obvious that one or 2 years good performance does not prove the value of a fertilizer treatment.

This program is based also on the fact that the sandy soils are relatively uniform in chemical and physical characteristics so that the application of a program fitted to the soil tends to bring the groves to relative uniformity also. The period required to bring various groves into good condition will of course depend considerably on the prevous treatment. It is only the uniformity of the soil that makes this possible.

Finally, we do not claim that this program is perfect or static. As in the Better Fruit Program, we are trying to set up these recommendations based on research and practice to the present time and to modify them as research reveals new information. This has worked excellently in the case of the Better Fruit Program and should do as well for fertilizers. We do not claim that it is the best possible program, and we are not even attempting to guess at the probable outcome of experiments; for where the results of research are not clear-cut, we are relying on good standard practice rather than recommending a modification which we merely hope will be correct. Guessing at the outcome of experiments has not been too profitable so far but anyone who wants to do so has that privilege on his own responsibility. He may be correct and be years ahead of the Experiment Station, or he may injure his grove seriously, but this is his responsibility. The program here suggested is, therefore, based on the long-time view and not on this year's crop alone; and the recommendations are made on the reasonable assurance that the grove will remain in good condition indefinitely. To compare it with the field of medicine — it is **preventive** rather than **curative**, like paying a doctor to keep you well rather than paying him to cure you.

The fertilizer recommendations are in the form of a set of ratios which can be used as a fertilizer formula if so desired. The order of listing the various nutrients is as follows:

N — P_2O_5 — K_2O — MgO (Water Soluble) — MnO — CuO. They are set up in this form for several reasons. First, elements should be applied in ratio to other elements rather than in specific amounts; second, the fertilizer analysis form is more familiar to the majority of growers than any other form (a few may prefer to set up their applications in terms of pounds but this can be easily calculated from the ratios); and third, the formulation of relatively higher analysis mixtures may be easily calculated from the ratios indicated. In connection with the latter point we recognize that there will be some criticism of the fact that we have based these ratios or mixtures on 3 to 4 percent nitrogen. This was done after considerable study for a number of reasons. More growers are familiar with the use of 3 and 4 percent nitrogen mixtures in the citrus belt, as evidenced by the fact that more 3-8-8 is sold than any other mixture. Moreover, in setting up the original set of ratios several years ago, it was necessary to use this level of nitrogen in order, with the materials commonly available at that time, to make the 40 percent organic nitrogen mixtures come within 2,000 pounds when all the needed elements were included. Finally, the experimetal work on these programs was started while hand distribution of

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THE AGRICULTURAL SITUATION

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veloped from time to time due largely to diversion to the manufacturing of war packages by some mills and to labor shortages in the crate mills and in providing timber for mills to operate. Where emergencies have arisen the folks in the department of agriculture and WPB have arranged for obtaining priorities high enough to obtain containers to prevent loss of food crops. In order to be prepared for fall crops it would seem that shippers should arrange this summer for obtaining supplies needed well ahead of the shipping season.

Transportation. The railroads have so far been able to handle the tonnage offered in spite of many handicaps and difficulties. Shippers should cooperate to the end that equipment is made to render maximum service. Some new farm trucks have been released recently, largely for replacements and for expended acreage. Everything possible needs to be done to make the present limited inventories of new trucks last until such time as new trucks are built. The ODT can assist truck operators to obtain parts that are needed to keep trucks in operation. Contact the local ODT office if parts are not available from other sources.

As far as the production goals in Florida are concerned, the situation is about as follows: South Florida has already shipped up to this date the greatest tonnage of fruits and vegetables in history. The balance of the state has more land prepared and planted than in 1942. It now appears the Irish potato acreage will be below the goal; however, the sweet potato acreage will exceed the goal by several times the shortage of Irish potatoes. Only about 65 percent of the cane acreage was harvested due to labor shortage, especially early in the season, and to freeze damage. The poultry, dairy, beef, and hog goals will apparently be met unless the shortage of feed interferes. The planted acreage of peanuts amounts to about 420,000 acres and with an average growing season and sufficient labor at harvest time there should be enough to feed out the hogs and dig approximately the 250,000 acres in the goal. The corn acreage will meet the goal requested. Cotton and tobacco acreage will be less than the goal.

Some things have happened which may make you wonder. Crops like celery for which a reduction in was called for came through the freezes and because there was a shortage of green vegetables celery supplied a vacant spot in the market and brought the highest prices on record. Cucumbers and watermelons were on the non-essential and reduced acreage list. The cuke crop from a small acreage has sold for very high prices and watermelons from a small acreage have started out at very high prices. There were no ceilings on these crops. The Irish potato yields were cut by freezes and the ceiling prices have caused much controversy and grower dissatisfaction as some growers will not get back the cost of production. This is in the face of current wholesale prices for old potatoes approximately two to three times the ceiling price for new potaties.

The livestock feed situation for high protein meals is critical for the next four months. Unless some means can be found to obtain about 15,000 tons of oil meals, dairy and poultry production will be greatly curtailed. Since April 1 Florida has purchased approximately 175 cars of government feed wheat; in addition to this a good tonnage was obtained under the previous feed wheat program. This program has been very beneficial to Florida livestock and poultrymen.

EDITORIAL

(Continued from cover page)

for themselves with one year's crop during the past season, while many paid better than fifty percent of the valuation.

The conditions existing in Texas during the past season were not unlike the conditions existing in Florida, but they cannot be accepted as permanent. War and its attendant stimulation of excessive labor employment at high wages will not continue indefinitely, and when the reaction comes, the citrus industry along with other industries, will feel the shock. However, it must be taken as an established fact that the citrus industry has taken a permanent hold on the Lower Rio Grande Valley and must be reckoned with in plans for the betterment of the industry as a whole.

STUDIES OF BORON DEFICIENCY IN GRAPEFRUIT

(Continued from page 5)

growth of citrus. Bot. Gaz. 89: 410-413, 1930.

4. ———— and L. J. Klotz. Some anatomical and physiological changes in citrus produced by boron deficiency. Hilgardia 5: 175-197, 1931.

5. Miller, R. L., and Ione P Bassett. Effect of arsenic insecticides on orange trees in Florida, U. S. D. A., Tech. Bull. 350. 1933.

6. Morris, A. A. Some observations of the effects of boron treatment in the control of "Hard Fruits" in citrus. J. Pomol. and Hort. Sci 16(2): 167-181. 1938.

CITRUS GROUPS SEEK RETURN OF SECURITY TAXES

Eight citrus grower associations of Florida have filed suits in Federal court at Tampa, seeking return of Security taxes which they claim were erroneously assessed and paid.

The eigth suits aggregate a total of $36,089. The associations represented and the amounts they seek to recover follow:

Elfers Citrus Growers association, Elfers, $1896.

Winter Haven Citrus Growers association, Winter Haven, $4487.

Haines City Citrus Growers association, Haines City, $4225.

Lakeland Citrus Growers association, Lakeland, $1083.

Florence Citrus Growers association, Folrence Villa, $5841.

Waverly Growers cooperative, Waverly, $13,871.

The Dundee Citrus Growers association, Dundee, which asks $1975.

The Domino Citrus association, of Bradenton, which seeks $2711.

PINELLAS COUNTY GROVES RECOVER

Citrus groves in Pinellas county have completely recovered from the spring drought and are now in fine condition with a fair crop of fruit, according to County Agent J. H. Logan. Cover crops are also growing well.

By pollinating flowers and insuring the setting of a crop of fruit, the lowly bee is a vital war worker.

A RESUME OF FEEDING AND SPRAYING CITRUS TREES FROM A NUTRITIONAL VIEWPOINT

(Continued from page 7)

fertilizer was still standard, and high analysis mixtures frequently had damaged roots in the band where the fertilizer was commonly applied under the method then in vogue. Some of the reasons mentioned above are not important now but in any event by a few calculations the indicated ratios may be raised to any desired higher level **providing all are raised in proportion,** i. e., a 6-12-16-2-1-½ is not a double strength form of a 3-6-8-2-1-½. The proper double strength formula would be a 6-12-16-4-2-1. This error has been made a number of times by growers attempting to follow our recommendations with entirely unsatisfactory results.

I want to add one further caution regarding high analyses, based on checking extensively on the use of such mixtures, which is that the average citrus grower almost never cuts his poundage in half when doubling the analysis. This is manifestly due to the fact that he has poundages better fixed in his mind than analyses, and he will almost invariably use 20 pounds of a 6 percent goods where he would use 30 pounds of a 3 percent goods. In careful checking, we have frequently found that his theoretical savings in using high analysis mixtures is more than dissipated by his wasteful use of fertilizer. Double analysis fertilizers are only cheaper when the rate of application is reduced in proportion to the increase in analysis.

Recommendations

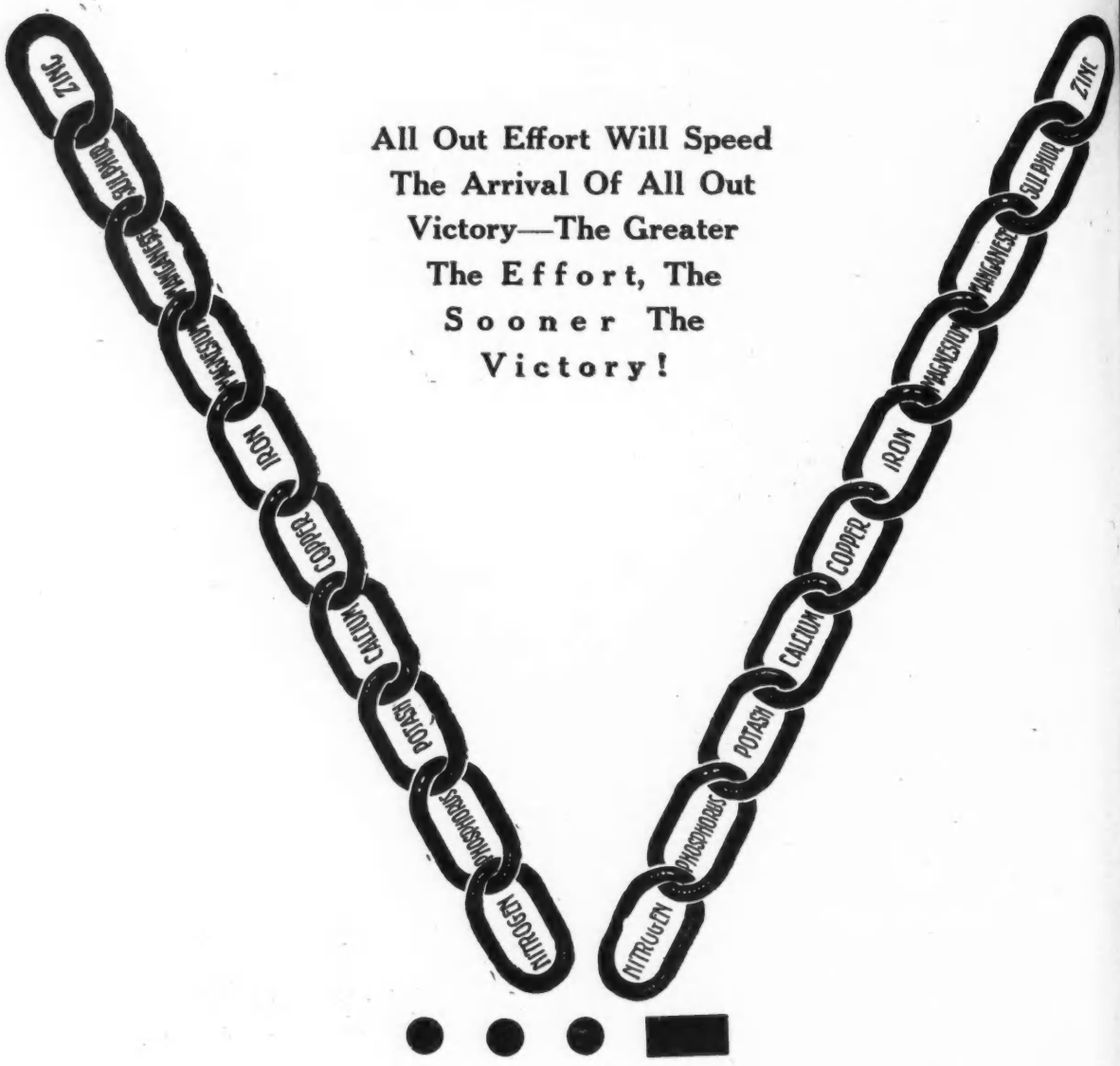
Nitrogen

In the original program the nitrogen level was set at 3 percent but has recently been raised to 4 percent so the main problem for discussion is the source of nitrogen. The question of organic versus inorganic nitrogen has raged for several years without the benefit of any real understanding of the matter. The question first came to the fore in the late 20's while nitrogen, phosphorus, and potash were still considered a complete fertilizer; and the trend to inorganics undoubtedly was a large factor in bringing on the very bad grove conditions prevalent in the early 30's. This is forcibly borne out by the nitrogen source experiment at the Citrus Experiment Station (Camp 4). One tier of plots received phosphate from acid phosphate and potash from sulfate of potash. The nitrogen sources tried were nitrate of soda, sulfate of ammonia, and dried blood. In the early years of this experiment sulfate of ammonia did very well and was widely cited as the basis for use of sulfate of ammonia which was the cheapest form of nitrogen. Eventually, the inorganic plots went out of production, however, with the same troubles which beset many groves, i e., bronzing, frenching, and dieback, while the adjoining plots which received all of their phosphate and approximately 65 percent of their nitrogen from bone meal remained in fairly good production by standards of that day. This latter tier of plots has been cited (Bryan (2)) as the basis for the conclusion that inorganics were as good or better than organics because the nitrate of soda and sulfate of ammonia plots were slightly superior to the plot receiving blood but without also pointing out that these were only supplementary sources to bone meal which supplied around 65 percent of the nitrogen in organic forms. The half of the table in which the sources under discussion, i. e., nitrate of soda, sulfate of ammonia, and blood, were used as the sole sources of nitrogen was omitted but showed that trees receiving either nitrate of soda or sulfate of ammonia as the sole source of nitrogen declined so badly they went out of production. If you would ignore soil differences between these plots, previously pointed out by Camp (4), the only conclusion that could legitimately be drawn would be that inorganics as supplements in a 65 percent organic mixture were better than a 100 percent organic mixture; and if the adjoining acid phosphate tier of plots were included as they should have been, then it would be necessary to conclude that inorganics are inadequate as the sole source of nitrogen. As mentioned previously (4), however, these plots were operated on an N-P-K basis, and any conclusions from them are untenable when applied to modern conditions since the differences in production and growth were due primarily to impurities in the materials used rather than in nitrogen values per se. In 1938 the needed elements were applied to parts of these plots with remarkable results but the tier of plots receiving bone meal is still superior because of a better start at that time. Consequently, these plots must be dismissed as valueless as a basis for comparing nitrogen sources.

In 1938 a magnesium experiment was started in which inorganic nitrogen was used in all but one set of duplicate plots at one magnesium level. It was believed that the magnesium level used for these plots would be adequate, but this was an error in judgment; and both the inorganic and the duplicate organic plots are slightly below optimum magnesium level although levels for other elements are adequate. To date the only definite difference is in fruit quality, with the fruit from the organic nitrogen plot being visibly superior on the grading belt. The difference might be due either to a steadier supply of nitrogen or to the supplying of some hitherto undetected element that is needed in very small amounts. The latter is interesting as speculation since the adherents of inorganic nitrogen have generally claimed that the original failure of inorganic nitrogen was due to the lack of secondaries as impurities and, now that these are supplied, inorganic nitrogen as a sole source of nitrogen should be

(Continued on page 12)

Florida Growers Will Be Acti
Plan Ahead For Their Comin



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A RESUME OF FEEDING AND SPRAYING CITRUS TREES FROM A NUTRITIONAL VIEWPOINT

(Continued from page 9)

entirely satisfactory. If the sole difference between inorganic and organic nitrogen is the secondary elements then this argument in favor of inorganics is little better than it was originally as there is no definite evidence that we are through adding elements to fertilizers any more than there was that nitrogen, phosphorus, and potassium were all that was necessary in 1930. While inorganic nitrogen is certainly holding up well where all the needed elements that we recognize are supplied, it should be remembered that the sulfate of ammonia, acid phospha e, and potash program was satisfactory for longer than these plots have been carried on before the trees declined. It would seem, therefore, that in view of the lack of a case in favor of all inorganic nitrogen and the history of favorable results from the use of some organic nitrogen, both practically and experimentally, it would be sensible to use some organic nitrogen. We would suggest 30 to 40 percent organic nitrogen as long as this is obtainable, and where some reduction is necessary to maintain this level in the June application at the expense of other applications as this application must face the most drastic leaching. Whenever it is settled that all of the deficiencies which might be supplied by natural organics are known the question will still have to be settled as the the period of availability of the various forms of nitrogen and its importance.

Phosphate

We tentatively set the level of phosphoric acid at 6 percent and so far have found no reason to change it except by raising the level of nitrogen to 4 percent from the original 3, thus changing from a 1:1 ratio to a 1:1½ ratio. Like nitrogen, the case on phosphorus has been obscured by an avalanche of mostly unsubstantiated discussion. The relatively liberal use of phosphorus has been general for many years with good results; but the only experiment on sandy soils, in which other deficiencies have been taken care of, is now in progress at the Citrus Experiment Station and will require some years to complete. The standard levels in practice for many years have been either 4:8 or 3:8 nitrogen to phosphorus ratios. The ratio has been narrowed in our trials because we anticipated that with pH control of the soil there would be a better availability of phosphorus than under conditions of very acid soils, and the work of Peech (unpublished) has confirmed this. So far, however, we have not felt justified in a more drastic lowering of the phosphate. Lest some of you believe that phosphate deficiency is not of possible importance, I would point out that in experiments on low phosphate, muck soils at Davie conducted by Neller and Forsee (15). phosphate deficiency resulted in fruit that softened prematurely and shed before becoming entirely ripe. The over-all effects were like those of other deficiencies, i. e., light crops of poor quality fruit. We have seen no reason, therefore, to recommend a lower ratio than we know to be safe.

The case for much lower ratios as commonly presented was not considered acceptable for several reasons. In the first place, it is not based on any plots maintained at low phosphate levels for a period of years with all other needed elements supplied. In the second place, it involves the assumption that the phosphate available to citrus trees is that extractable by weak acid, an assumption that has not been proved (Bryan (1)). Finally, it is based on the assumption that there has been a great accumulation of available phosphorus in old groves (1). The last assumption has really been the crux of the whole question but is not tenable because Peech (unpublished) found that the very large accumulations of phosphate reported from some groves were related to the source of phosphate used more than to the age of the trees. No case of extremely high phosphate in sandy soils has been found where acid phosphate was the sole source of phosphate, but such accumulations could be expected wherever bone meal had been used. This is very well illustrated by two tiers of plots at the Citrus Experiment Station, one tier having received phosphoric acid from acid phosphate and the other from bone meal since 1921. All plots received the same amount of phosphoric acid by standard control methods. Camp (4) reported Peech's analyses for acid soluble phosphoric acid on these plots which show roughly about 10 times as much acid soluble phosphoric acid in the bone meal plots as in the acid phosphate plots after about 18 years. Recently Jamison (10) has studied the same plots and found that the bone meal plots now contain approximately 3 times as much total phosphate and 8 times as much acid soluble phosphate as the superphosphate plots. Since the same amounts of phosphoric acid as determined by standard control methods were added in each plot, it is obvious that either the method of determining available phosphate in the soil is erroneous or the method of determining available phosphate in fertilizers is incorrect or, more probably, both. This emphasizes forcibly the very inadequate basis for the widespread discussion on phosphate and so far no one has carried out sufficient research work to clear up the matter.

Considerable emphasis has been placed on the supposed relationship between phosphate and zinc and copper availability (Bryan (2)). The basis for this has not been work on Florida soils but a publication by West (30) in which he reported evidence that frenching followed the use of superphosphate in his experiments in Australia. The whole argument that the presence of frenching and dieback in Florida is due to the use of phosphate is obviously untenable in view of the fact that the first deficiencies that show up on young trees are those of copper and zinc and that soil applications of copper and zinc are much less satisfactory on such young trees than sprays.

Since virgin sandy soils contain little active phosphate and since these deficiencies show up immediately without waiting for phosphate applications the contention that the widespread presence of these deficiencies is due to the use of phosphate is obviously without foundation; and any grower who has developed an acreage of grove on such soils could substantiate this from his own experience even without any experimental evidence. In order, however, to clarify the situation it is well to review thoroughly the evidence on this point. West (30) felt that under his conditions zinc deficiency followed phosphate applications but his evidence on even this point was uncertain. Moreover, he produced no evidence to show that the occurrence of zinc deficiency symptoms was due to the fixation of zinc by phosphate in the soil nor did he give any information on the type of soil on which he carried out his work to enable us to determine whether the soil there is anything like Florida soils. He does not even offer any evidence, either by soil or plant analysis, that the zinc deficiency was brought on by zinc fixation. This is an important point in interpreting the paper. Many growers reported in the 30's that bronzing was brought on by the use of copper or zinc or both in their groves, and certainly it was induced by their use in many cases. This was due to the fact that magnesium was acutely deficient in their soils as well as either copper or zinc or both. Bronzing (magnesium deficiency symptom) did not occur because the other deficiencies inhibited fruit production; but when they were corrected and heavy crops were set, bronzing became acute. This did not mean that either copper or zinc fixed magnesium but merely that they were limiting factors to production; and when they were supplied, magnesium, which is related to fruit production, became the limiting factor. This has been beautifully demonstrated in the plots at the Citrus Experiment Station and repeatedly pointed out to growers viewing the plots. It is quite possible that under the conditions of West's experiments phosphate was a greater limiting factor than zinc but that the latter was also deficient; and when phosphate was supplied, then zinc became the limiting factor. The same quite probably applies to the interpretation of Neller and Forsee's (15) experiments on muck soils (See Jamison (10)). The same interpretation applies to the nitrogen-copper relationship. It could be said that applications of nitrogen induce copper deficiency (dieback) but that definitely does not infer that nitrogen fixes copper; but only that the ratio between nitrogen and copper has become too wide and copper is consequently a limiting factor. In order to clear up the matter still further, Peech

(19) and later Jamison (10) have studied the behavior of copper and zinc in the soil and have found absolutely no evidence of fixation of copper and zinc by phosphates at the usual rates of application, but did find fixation by the organic matter in the soil. This is reviewed by Jamison (10) in detail. Fudge (unpublished data) found no significant difference in the absorption of copper by the tree from soil applications in the bone meal and superphosphate plots already mentioned. This is of interest from two angles; first, the very high phosphate in the bone meal plots as compared with the superphosphate plots did not reduce the amount of absorption; and second, superphosphate did not appear to inhibit absorption more than bone meal. Since the proponents of the idea that phosphate applications brought on zinc and copper deficiencies in Florida first blamed it on phosphate in general and then gradually shifted to blaming acid phosphate, the above covers both the old and new viewpoints quite adequately. It will be seen from the above review that so far no one has produced any data whatever to support the idea that phosphates fix copper and zinc in Florida citrus soils, and in fact all of the evidence is to the contrary.

The only plots in which varying ratios of phosphate are being or have been tested with all of the other elements supplied are those at the Citrus Experiment Station which are too new to be conclusive. Therefore, in consideration of the entire situation, we are making the recommendation of 6 percent phosphorus which has proved entirely satisfactory, both experimentally and practically. This recommendation may be modified later as our experimental work develops.

One further caution should be made with reference to the interpretation of analytical data. Analyses of fruit and leaves are commonly reported as percent or pounds of the element phosphorus (P) whereas phosphorus in fertilizers is always calculated as phosphorus pentoxide (P_2O_5) which contains only 43 percent phosphorus. If the fertilizer percentage were figured on a basis of phosphorus, the 4 to 6 ratio would become a 4 to 2.6 ratio. The same problem arises in connection with all of the elements except nitrogen since the oxides are used as the basis for calculating fertilizer mixtures, whereas the element itself is commonly used in reporting either plant or soil analyses.

Potash

The case with regard to potash is much the same as that for phosphate. We started our program work with 8 percent potash on the grounds that the ratio of 4:8 or 3:8 had been satisfactory for many years, and there was no tangible case in favor of a reduced ratio. Only one set of plots has been run for a prolonged period with varying ratios of nitrogen to potash. These plots are located at the Citrus Experiment Station and were started in 1921. Only nitrogen, phosphorus, and potash were considered with ni-

trogen at 3 percent and potash at 3, 5, and 10 percent. In 1930 the 10-percent plots were showing signs of distress and Ruprecht surmised that it might be due to high potash inhibiting the intake of nitrogen but stated that he had no data on this point (20). The surmise was natural at the time in view of the fact that most people were trying to explain all the yellowing of leaves which was developing on a basis of nitrogen deficiency. Ruprecht was subsequently cited (2) as the authority for the direct statement that high potash reduced the intake of nitrogen but the reference given as the basis for the citation (Ruprecht (2)) does not mention anything concerning a nitrogen-potash relationship so that it may be safely assumed that the earlier reference given (20), which is the only reference to a nitrogen relationship made in the reports on this project, is the basis for the citation. This is explained in some detail as it constitutes the only evidence cited to support the idea that high potash ratios are injurious; and since the obvious basis for the citation was, by Ruprecht's own statement, only a guess without any supporting data, then the whole case against high potash is without tangible support.

As a matter of fact, the 5 percent plots and eventually the 3 percent plots in the experiment declined in condition. The decline of the plots was, of course, due to deficiencies of magnesium, copper, zinc, and manganese. The magnesium deficiency was particularly acute, and the soil showed the lowest amount of exchangeable magnesium that we have ever found in a grove soil. The earlier decline of the 10 percent plots was probably due to the effect of potassium on the leaching of magnesium. In 1938 the plots were treated with the various needed elements and all plots have shown a remarkable recovery. An interesting angle to this, which bears on the question, is that the 10 percent plots are now producing on a par with the others and have really made more of a recovery than the others since they were in the worst condition when the corrective treatments were applied. It is obvious that the symptoms reported by Ruprecht in 1930 (20) were not those of excess potash but were due to deficiencies, mainly of magnesium.

Further reason for not reducing potash in our recommended ratios for the time being is the fact that Peech found that there was no accumulation of potash in the 10 percent plots and that consequently the trees were dependent on the yearly applications. Further evidence on this point has been presented by Kime (11) at this meeting showing the very rapid loss of potash in Florida sandy soils.

Some differences now seem to be developing in the revamped plots mentioned above, and an additional set of plots was started on young trees in 1939 which should answer definitely the question as to whether the ratio of N:K2O should be narrowed. In the meantime the ratios indicated have given excellent results and others are problematical.

Magnesium

Based on earlier experiments soluble magnesium was set at 2 percent where dolomite was being used to control pH, giving a ratio of nitrogen to magnesium of 3:2. Subsequently, it has been found that where lime or other basic materials which are low in magnesium, are used to control pH, the ratio must be 1:1 to give satisfactory results. This soluble magnesium plays much the same role as quickly available nitrogen such as nitrate and serves to build up the reserve in the tree. Dolomite alone probably becomes soluble too slowly to give thoroughly adequate amounts of available magnesium, and the large amount of calcium in the dolomite increases the leaching of magnesium and slows down the intake by the tree through antagonistic action. Where strictly water-soluble magnesium such as the sulfate is used in the fertilizer in conjunction with dolomite to control pH, it is safe to leave the level of magnesium at 2 percent (MgO) when nitrogen is used at 4 percent, providing the grove has been entirely brought out of bronzing and is in good condition. Where materials are used that must be made available by reaction in the fertilizer or soil, it is safer to use 3 percent. Also, when trees are in a doubtful condition or when the trees are seedy grapefruit, which have a higher magnesium requirement, the magnesium should be used at 3 percent.

The maintenance of an adequate level of magnesium is particularly important in avoiding alternation of cropping. Where bronzing is not particularly noticeable but the magnesium supply is marginal, a tendency to crop alternation will be more pronounced. Evidence of this can be seen at the Citrus Experiment Station at the present time. Seedy grapefruit fully supplied with magnesium and other elements have set a good crop for next year but with slightly lower magnesium have set a much lighter crop, both having this year a heavy crop which was held late. The plots receiving the lower amount of magnesium showed only a scattering of magnesium-deficient leaves and would not have been considered magnesium-deficient by the average grower.

The role of dolomite will be discussed further in the section on pH control.

Manganese

The level for manganese was set at 1 percent in our original layouts as that amount which would keep trees in good condition on acid sandy soils and free from the leaf symptoms of manganese deficiency when no nutritional spray was applied. In fact, this level was set sufficiently high so that it was believed that as long as the soil was below pH 6.0 the manganese spray would be unnecessary for maintenance. This level has been sufficiently high to serve the purpose of eliminating the deficiency but on the

acid sandy soils it has been difficult to show increases in yield due to manganese application. This has not been true on soils with a pH above 6.0, but there is a question as to whether at a lower pH the deficiency is sufficiently acute to cause a marked reduction in production. As a matter of fact, the leaf pattern usually is apparent on the growing leaves but tends to disappear as the growth hardens. This indicates that the deficiency on such acid soils is usually marginal and the tree cannot store sufficient manganese to take care of a flush of growth, but over a longer period can pick up enough to correct the deficiency symptoms. We have not found any marked peel color due to variations in manganese supply, whereas magnesium seems to be a controlling factor in peel color. However, we have been able to show that manganese deficiency reduced the pulp color, although not very greatly.

The level indicated may, therefore, be a little high but is considered entirely safe and advisable since it has not been possible to build up any reserve of available manganese in sandy soils. Experiments now in progress may considerably alter the levels recommended. It might be said in this connection that the level recommended was determined early in the work before the other deficiencies were fully corrected, at which time the 1 percent was definitely indicated by the experiments. With improved grove conditions due to the use of the other elements and the consequent improvement in root systems, better absorption of manganese at low levels is apparently being obtained.

Copper

Copper is recommended at one-half percent when a copper spray is used and at 1 percent where no copper spray is used. However, the results obtained without the spray have not been found so satisfactory as where the spray was applied, possibly due to its fungicidal action as well as its nutritional action. Early in the work no copper was recommended in the fertilizer when bordeaux was used for melanose control; but after this was extensively replaced by proprietary copper sprays, which are apparently not absorbed by the leaves as readily as bordeaux, it was found necessary to add copper to the fertilizer mixture. The one-half percent indicated has so far been quite satisfactory when used in connection with any of the commercial copper sprays, but it may be found desirable to raise this level where large amounts of fertilizer are used.

Zinc

Zinc is not recommended in fertilizer mixtures for Norfolk, Blanton, and Eustis soils. The only experiments reported in which soil applications gave results comparable to those obtained with sprays were reported by Mowry and Camp (14, see pg. 27). The experiments reported were carried on in the Gainesville area on Gainesville, Hernando, and what is probably now called Arredondo soils; and these types are not common in the citrus area. An application of ¼ to ½ pound of zinc sulfate per tree per year gave excellent results on these particular soils, and trees on muck soils in the Davie section have also been found to respond fairly well to soil applications (15).

On sandy soils such as Norfolk, Blanton, and Eustis, amounts up to 20 pounds per tree gave entirely unsatisfactory results. There has been a great deal of loose discussion regarding the efficacy of soil applications of zinc but these statements are not based on actual experiments except in the one case cited (14). Just why zinc fails to give results when applied to the usual sandy citrus soils has caused considerable speculation, but Peech (19) established that it was probably due to combinations of zinc with the organic compounds in the soil. The question of availability of zinc has been discussed in the section on phosphoric acid, and for further details the reader is referred to that section.

Fertilizer Program In General

The amount of fertilizer to use is difficult to define in a paper of this nature. In general in the experimental blocks we have reached the point where we are using approximately 0.2 pound of nitrogen per box of fruit produced on trees on rough lemon stock on light Norfolk and Blanton soils. This was not attained immediately on changing the program but represents an end attained in the best treatments after a period of years of treatment. Many of the blocks were producing no more than a box of fruit to 0.5 pound of nitrogen when these newer programs were started, and in some cases the utilization of nitrogen was even higher. It is not certain that the figure of 0.2 of a pound per box of fruit can be attained in all groves whereas some may even exceed this. Soil type, tree condition, spacing, rootstock, variety, and age of grove, as well as many other things, will modify the production in ratio to nitrogen; but the above figure has been attained at the Experiment Station where all deficiencies were properly taken care of and the program used in its entirety, including the spray program which will be discussed later in this paper. Sour orange, sweet orange, and grapefruit stocks have been found to require more nitrogen than the above when growing on the sandy soils, and some groves contain varieties or strains which have not produced sufficiently well to reach the above figure. It has been obvious in many cases also that excessive amounts of nitrogen have been used in groves in which equal production could have been obtained with less nitrogen. Reduction of amounts of fertilizer suddenly to the above level should not be attempted but the attempt should be made to correct all of the deficiencies and to get a complete program into operation; then the rise in production per pound of nitrogen will come automatically as the limiting factors are eliminated.

The fertilizer ratios as set up are as follows:

N, 3 or 4; P_2O_5, 6; K_2O, 8; MgO (water soluble), 2 or 3; MnO, 1; CuO, ½. Some of the most successful blocks receive a fertilizer of this analysis at all 3 applications in approximately equal amounts; but the ratios as set up are for the season, and other programs which give the same seasonal ratios are possible. For instance, the following will give about the same total seasonal applications:

Spring—8-0-8-6-2-1
Summer—3-8-8-2-1-½
Fall—3-8-8-2-1-½

Another program which has not giv-

(Continued on page 18)

The LYONIZER

Department

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Reports of Lyons Field Men . . .

POLK & HIGHLANDS COUNTIES

J. M. (Jim) Sample

This section is still well ahead of the normal water supply and groves continue to look extra well. Most trees put on another growth in late July and early August. The fruit crop is sizing up well as a result of the rains. There is quite a bit of melanose on grapefruit that did not get copper sprays last spring, and it is at this time of the year that it becomes so evident that a complete spray program is necessary if we are to grow real quality fruit. Cover crops have been either mowed or chopped and some late oil spraying is being done. Rust mites have been particularly bad and the rainy weather has been a handicap in controlling this pest. Some fruit is being bought now with the demand chiefly for early oranges and some tangerines. Most growers feel that the approaching season will prove very profitable.

HILLSBOROUGH & PINELLAS COUNTIES

C. S. (Charlie) Little

We have been getting an abundance of rain and our water table at this time is at a more desirable level than at any time for the past several years. Cover crops have made a very fine growth this summer and we will have a large tonnage of organic matter to work into the soil this fall. We are a little discouraged over our fruit crop for this season as most varieties have a light crop. However, there is a bright side to the fruit question in that we have never seen as much activity among the fruit buyers at this time of the year. Prices are being offered on all early varieties that will more than compensate for a light crop and if the early varieties cannot be bought without taking the entire crop then the offer is made to include the crop. Groves throughout the territory are in splendid condition with an abundance of new growth that will be an important factor in setting a new crop of fruit next spring.

NORTH CENTRAL FLORIDA

V. E. (Val) Bourland

Last month we made the statement that we had not been worried too much with rust mite and since that time we have been warned by a number of growers that we evidently had not made inspection trips through their properties. Well, it so happens that soon after making this report last month there appeared the most severe rust mite menace we have ever seen. It has been a constant fight for the past four or five weeks. (You are right Mr. Sley and others). We have been fortunate this summer in getting plenty of rain and now our trees are in tip-top condition. There is a great deal of talk about the amount of fruit crop on the trees. We are still not making any definite estimate of our crop compared with last season, but we do state that at the end of the coming shipping season we believe that most growers will be satisfied with their production records. From the interest being shown by the fruit buyers it appears that we will have a very strong market on all varieties of fruit.

SOUTHWEST FLORIDA

F. W. (Felton) Scott

Vegetable growers throughout this section are as busy as can be getting their plans under way for the fall crops. Seed beds have been doing well and heavy plantings will soon be under way. Without exception growers are planting the essential crops as classified by our Government and with good weather and a break in the labor situation it is safe to say that this section will do its part in furnishing plenty of fresh vegetables for the nation this winter. Groves have been selling at good prices and a large acreage has changed hands in this territory. In some sections, especially Hardee and DeSoto counties a large volume of fruit has been sold in bulk. Very attractive prices are being offered for all varieties of early oranges and there is considerable interest in all other varieties. The heavy rains that we have had this summer will necessitate an early fall application of fertilizer and in many cases growers are planning to fertilize in September.

WEST CENTRAL FLORIDA

E. A. (Mac) McCartney

Due to varied conditions it appears that this territory will have a considerable curtailment in the number of growers that will plant vegetable crops this fall. Many of these growers have left their farm for what appears to them as opportunities to make more money in some other field. This is true in the case of the small grower. The above statement is not to be interpreted as meaning that we have had a general exodus from the farm, because this is not true and this territory will have a large acreage of winter vegetables growing before we make our next report. The citrus crop in this section is showing up unusually well with good quality that will bring a premium price on the market. Rains have been plentiful, cover crops have made a fine growth and all citrus trees have had very extra fine flushes of growth. There is a great deal of fruit being sold on the tree at this time. Prices being paid appear to be very good, but there are many growers holding their crops in the belief that the possibilities are good for a higher scale of prices.

A RESUME OF FEEDING AND SPRAYING CITRUS TREES FROM A NUTRITIONAL VIEWPOINT

(Continued from page 15)

en quite so satisfactory results as the above and which has consequently been abandoned in our experiments is as follows:

Spring—14-0-14
Summer—3-8-8-4-2-1
Fall—3-8-8-2-1-½

In this program the minor elements are doubled in the summer application to make up for their omission in the spring.

For those desiring to use higher strength mixtures, it should be noted that a 6-12-16-2-1-½ is not a double strength mixture of the formula 3-6-8-2-1-½. This mistake has been made many times with very unsatisfactory results. The proper double strength formula would be 6-12-16-4-2-1. In other words, all percentages should be multiplied by the same figure and not just the nitrogen, phosphorus, and potash. This is particularly important with regard to the proper increases in magnesium and copper, for while the ratios recommended for phosphate and potash may be considered quite liberal, the recommendations for magnesium and copper and possibly manganese may be considered as minimum recommendations; and when nitrogen is increased it is necessary that these be proportionately increased. In fact, due to the generally greater use of nitrogen when the more concentrated mixtures are employed, it may be desirable to increase the copper more than a proportionate amount.

It should be kept in mind at all times that the attainment of high efficiency in the utilization of nitrogen or any other element is dependent upon high production. The presence of any deficiency in any appreciable degree results in reduced yield and makes the attainment of high efficiency impossible. It is in this connection that a complete program becomes of the greatest importance; too many scales, too much melanose, omission of zinc spraying, or insufficient amounts of any element needed may make maximum production impossible and thus reduce the results obtained from those things which have been done.

pH Control

Along with the introduction of several new elements in the nutritional program came the idea of pH control of the soil (Peech (18)) as a basis for the maintenance of maximum fertility. In the earlier stages these recommendations were based primarily on studies of grove conditions as related to pH. Out of this work recommendations were made first that the pH be kept at 5.5 and later that it be brought up to 5.5 to 6.0 once per year. This was based on the fact that at pH figures from 4.5 to 5.25 groves were generally bronzed and otherwise deficient and that above 6.0 zinc deficiency was usually acute. At no time have recommendations been made by the Experiment Station that the pH be allowed to go above 6.0. Many have held that dolomite held no dangers at higher rates of application, but this is definitely not the case. Work by Jamison (unpublished data but see Jamison (9)) on availability and by Fudge (unpublished data) on absorption of manganese and copper have indicated that a pH figure of 6.0 is definitely the highest pH that should be attained. At the present time the evidence indicates that if it were possible to accurately maintain it, then a pH of 5.5 might be better than 6.0. Since maintenance of a constant pH is impossible, the present recommendation is to raise the pH to 5.5 to 6.0 once per year with a liming material such as dolomite. Lime or slag may be substituted for dolomite but the magnesium content of the fertilizer mixture would have to be raised to a 1:1 ratio, whereas dolomite furnishes considerable magnesium in addition to controlling the pH. This recommendation would mean that once per year the pH will be close to 6.0 but by the end of the year is likely to be close to 5.3 which gives a very desirable range. Large applications of dolomite which will raise the pH above 6.0 to 6.25 are definitely not recommended.

(Concluded Next Issue)

Citrus Growers To Conserve More Gasoline

Meeting with officials of the Office of Defense Transportation in Lakeland recently, members of all groups of Florida citrus interests, including growers packers, canners, processors and shippers, formed a statewide organization for the conservation of motor truck transportation.

To facilitate the work of the organization, the state has been divided into three districts with headquarters in Tampa, Orlando and Miami, each with its own local setup and personnel, but acting under and in co-operation with the state organization. District meetings for permanent organziation will be held in each of the separate districts early in September.

The state committee is headed by James C. Morton of Waverly with J. R. Bynum of Titiusville as vice-chairman and J. A. O'Rouke of Orlando as secretary.

After the district organizations have been set up, county organizations will be perfected in each of the citrus growing counties of the state.

The organization of these state, district and county committees is an important move on the part of citrus interests, since they will formulate the policies which will govern the industry in the conservation of gasoline, and which will be followed by the Office of Defense Transportation in enforcement of conservation measures.

The Tampa district will be composed of the citrus growing counties of the West Coast and West Central Florida, the Orlando district of the Central and East Central counties, and the Miami district of the Southern counties in the "belt."

The organization will be free to formulate its own policies without control from Washington. Dairy, live stock, cotton and other industry interests have formed similar organizations which have been recognized by the Office of Defense Transportation, and have materially reduced the consumption of gasoline in the marketing of those products. The citrus organization is expected to act along similar lines and with equally favorable results.